[11.7.86] K7

PRELIMINARY REPORT

Subsurface Soil Exploration

Griffith Sanitary Landfill

Griffith, Indiana

Prepared for:

Mr. Don Torrenga

Torrenga Engineering, Inc.
Engineers & Surveyors
907 Ridge Road
Munster, IN 46321

K&S Testing and Engineering Inc.

9715 KENNEDY AVENUE • HIGHLAND, INDIANA 46322 • PHONE: (219) 924-5231

Nov. 7, 1986

File No. 220

Torrenga Engineering, Inc.
Engineers & Surveyors
907 Ridge Road
Munster, IN 46321

Attn: Mr. Don Torrenga

PRELIMINARY REPORT

Subsurface Soil Exploration
Griffith Sanitary Landfill
Griffith, Indiana

Dear Mr. Torrenga:

We have completed a preliminary subsurface exploration for the above referenced project. This exploration was performed in accordance with your verbal authorization.

This report includes a summary of our field exploration, site characterization and engineering analysis based on the soil borings. Additional work is underway to complete our assessment of the site and will be presented in a final report. In the enclosed topographical plot plan we are identifying the proposed locations for the monitoring wells.

We appreciate the opportunity to be of service to you on this. If you have any questions, please contact us.

Very truly yours,
K & S Testing and Engineering, Inc.

Dibakar Sundi, P.E.
Project Engineer

Petar Kostur, P.G.
President

DS:PK/cac

Subsurface Soil Exploration
Griffith Sanitary Landfill
Griffith, Indiana

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EXHIBITS

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EXHIBITS

1.0 INTRODUCTION

1.1 Purpose

This study was undertaken to assess the subsurface soil condition, assess the suitability of using new areas for placing fill within the existing landfill site.

The body of the report contains a summary of our field and laboratory activities and engineering assessments.

The field exploration procedures, boring logs and laboratory test data are attached with this report.

1.2 Background

We understand the landfill was opened in the 1950's, and has been in use since then. Additionally, we understand that this landfill is primarily used for sanitary waste disposal. Portions of this landfill have been filled and these areas are marked (Phase I through Phase IV) in the topographic plot plan.

1.3 Work Summary

Our field work consisted of drilling three (3) exploratory soil boring. In this report these borings are identified as Soil Borings 6, 7 and 8 or for brevity SB-6, SB-7 and SB-8. The soil borings were drilled with a CME-55, rotary drill rig, using 3.25 inch I.D. hollow-stem augers. Standard split-spoon penetration testing was performed as each boring was advanced to provide blow count data and soil samples for testing. During our drilling, the sampling was done continuously, to the entire boring depths. Ground water was observed and water levels recorded while drilling. At the completion of drilling at each location, the boreholes were grouted shut.

This field and laboratory work was combined with published geologic information and our experience to form the basis of this report.

2.0 SITE CHARACTERIZATION

2.1 General

The Griffith Sanitary Landfill site is located on the west side of Colfax Avenue. To the north, the landfill site is bounded by the C & O R. R. and to the south by the C & E R. R. The regional site location and topography are shown on Exhibit 1, which is the reproduction of the local U.S.G.S. topographic map.

2.2 Surface Conditions

The surface topography of the unused portions of the landfill area has a gentle slope or is flat. The filled area shown (Phase I through Phase IV) in the topographical plot plan (prepared by Torrenga Engineering, Inc.) is higher than the unused portions of the landfill site. There is an existing drainage ditch along the north side of the C & E R. R. A drainage ditch also exists on the south side of the C & O R. R. These two ditches are connected by a drainage ditch existing on the western portion of the landfill site. As shown in the topographic plot plan some excavations were recently made on the western portion near the C & E R. R.

The ground surface surrounding the landfill site is relatively flat with elevations around 630.0 feet, MSL. Locally, on the eastern edge of the site the surface topography is at a higher elevation. The site and the surface topography are shown in the USGS topographic map and are attached with this report.

2.3 Subsurface Conditions

2.3.1 Basis

The data base for the subsurface conditions presented in this report is the field work conducted during this study, published geologic information, and prior subsurface explorations. Our interpretation of the subsurface conditions is based on interpolation and inference between widely spaced borings.

2.3.2 Site Geology

The site is formed of sediments deposited late during the Wisconsin Age as lake-bottom and near shore deposits of Glacial Lake Chicago. These sediments consist of fine lake silt and clay, sand and fine gravel laid down as glacial outwash and as till inclusions, and clay-rich till units of varying thickness. The site is a part of the Calumet Lacustrine Plain, which is a geologically heterogeneous area that has interlayed sand, lake clay, and till, forming the bulk of the sedimentary units. These sediments are water-laid sands and clays; the wind-blown dune sands being next in abundance. The deposits in a particular locality, whether wind or water-laid, sand or clay have very similar strength properties.

2.3.3 Soils

In summary, the undisturbed areas of this site have about a 12.0 to 14.0 foot thick layer of brown or gray fine to medium sand. This sand has been excavated in the area of Boring 6. Underlying the sand, we typically encountered a preconsolidated silty clay. The thickness of this clay layer was noted to be about 16.0 feet (extends between elevation 619.09 feet and 603.29 feet) in Boring 7 and about 23.0 feet thick (extends between elevations of 620.31 feet and 597.31 feet) in Boring 8. In Boring 6 the clay starts at the surface and it extends to a depth of 12.0 feet (elevation 611.55 to elevation 599.55 feet). Underlying, Boring 6 and 8 found alternate layers of sand and clay to the total depth of the borings. However, Boring 7 encountered gray sand beneath the clay layer which extended to the total boring depth of 54.5 feet; elevation 578.59 feet.

The ground water was noted in the upper sand layer. During our field drilling, ground water was noted at about 3.0 feet in Boring 8 and about 6.0 feet in Boring 7. Additionally, the sand samples obtained at deeper depths below the upper clay horizon were also wet.

2.3.4 Bedrock

Bedrock was not found at this site to the depth of drilling at 54.5 feet. However, published geologic information accounts for the consolidated rocks of Lake County, which consists of more than 4,000 feet of limestone, dolomite, sandstone, and shale of the Cambrian through Devonian Age, which rest on a

granitic basement that is designated Precambrian. The rocks constitute a series of strata that are relatively flat lying, but that are gently flexed to form a saddle like structure. This saddle, a part of the Kankakee Arch, rises between the Michigan Basin to the northeast and the Illinois Basin to the southwest. Structural dip, or inclination of the bedrock units, is generally southeastward, although the dip is northeastward in the northeast sector of Porter County. The average dip is about 5 to 7 feet per mile.

The bedrock surface which lies beneath 15 to 270 feet of unconsolidated glacial material, is largely a preglacial erosional feature and is not reflected by the present glacially derived land surface. The highest and coincidentally the shallowest area of bedrock lies under the Kankakee Plain in Southern Lake County. This bedrock high is part of a northeast-southwest trending ridge of Devonian limestone and shale in the southern part of the two counties. The surface drainage was northward from all but the south edge of the area. This bedrock ridge was the drainage divide. Bedrock elevation ranges from a low of about 450 feet above sea level near Lake Michigan to a high of about elevation 650 feet on the ridge in the south, under the Kankakee Plain. The bedrock surface elevation of our study site is expected to be within elevation of 500 to 550 feet, or within 80 to 130 feet below the existing site surface.

2.4 Hydrogeology

2.4.1 Regional Hydrogeology

The regional hydrogeology in the Lake County area can be typified by a thin upper mantle of water-bearing soils about 20 feet or so thick. The water source is primarily direct infiltration of precipitation and these deposits generally drain to the nearest waterway leading to the Calumet River and then to Lake Michigan. The area is fairly level and the natural drainage is low. The relatively recent urbanization has extensively modified the topography by creating ditches and drains.

Clayey glacial tills underlie these water-bearing soils and form an effective aquiclude. The till is a homogeneous mixture of sand, silt and clay with silt and clay size particles being the predominant particle size. These silt and clay size particles form a relatively impermeable soil matrix. Stratified drifts of coarser materials are present below the upper clayey till.

Underlying the till is the Devonian shale and limestone and Silurian dolomite and limestone and is considered to be a source of partial potable water supply. This bedrock aquifer is most productive, and it has the greatest water supply potential. Contamination from the surface is not as great in the shallow bedrock as it is in the unconsolidated system.

2.4.2 Site Hydrogeology

The site hydrogeology is similar with the regional hydrogeology. In general, it consists of a layer of water-bearing sandy soils with a low ground water flow gradient, clayey glacial till, followed by coarser grained or clayey layered soils resting on bedrock.

We believe that the site ground water originates primarily from direct infiltration of rainfall. The existing ditches on the west and north of the site serve as a drainage from the site.

We believe, we penetrated the upper clayey till in the three borings completed during our fieldwork. We did not encounter any water-bearing silty or sandy seam and it was remarkably consistent, and correlates well with the regional hydrogeology. Grain sizes performed on the site clay show higher percentages of fines consisting of silt and clay size particles. Hydraulic conductivities were measured on two relatively undisturbed shelby tube samples. The values were determined to be 2.1×10^{-8} cm/sec. and 2.4×10^{-8} cm/sec. This clay is very stiff to hard in consistency.

3.0 SITE ASSESSMENT

3.1 General

The presentation of our site assessment is organized to first consider the soil characteristics, both physical and geochemical. We then have discussed future migration potential.

The following assessment and our summary presented are based on the information contained in the report, our experience and engineering judgement.

3.2 Soil Properties

3.2.1 Physical

The soil type at this site is well defined starting with outwash and eolian deposits of sandy soils in the upper layer, clayey till below it and again followed by sandy soils. In general the clayey till has low plasticity index, with moisture contents of about 15.0 to 18.0 percent range, about 90.0 percent fines and has a hydraulic conductivity in the order of 10^{-8} cm/sec. The granular deposits can be expected to exhibit hydraulic conductivities in 10^{-2} cms/sec. to 10^{-4} cm/sec. range depending primarily on the percent of silt in the deposit.

3.2.2 Geochemical

The cation exchange capacity testing was performed on the clayey till by Suburban Laboratories, Inc., Hillside, Illinois. The test results are typical of glacial deposits and are attached with this report.

3.3 Migration Potential

The significant aquiclude at this site is the clayey till found below the near surface water-bearing sandy soils. The clayey till appears continuous at this site and has lower hydraulic conductivity on the order of 10^{-8} cm/sec. Also the lower water-bearing sandy soil appeared to be under an artesian head as evidenced during the field drilling operation of Boring 6. from which assumptions may be made that the clayey till is providing a significant protection against leachate infiltration to the deeper water-bearing soils.

The potential for surface or near surface horizontal migration at this site may be likely, unless provisions are made to contain the leachate or prevent it to flow horizontally away from the site.

3.4 Summary

Based on available information, test results and findings as presented in this report, we conclude the following:

1. The soil conditions at this site generally conform with the published geologic and hydrogeologic information for the region.

2. The ground water in the near surface sandy deposit occur at a shallow depth from the surface.

3. It appears that the clayey till is serving as an effective confining aquifer, protecting the deeper water-bearing soils.

4.0 ADDITIONAL WORK

Our additional work is currently underway at the landfill site in order to verify our site assessment and to develop additional information which could be used to develop a safe operational procedure of the landfill.

The additional work which has been proposed to be performed at this landfill includes the following:

1. Additional deep borings to further explore the continuity of the aquiclude.

2. Ground water monitoring wells to check for ground water quality and gradient.

REFERENCES

1. Conversations with Torrenga Engineering, Inc.

2. Soil Borings, 1974 by Salisbury Engineering, Inc.

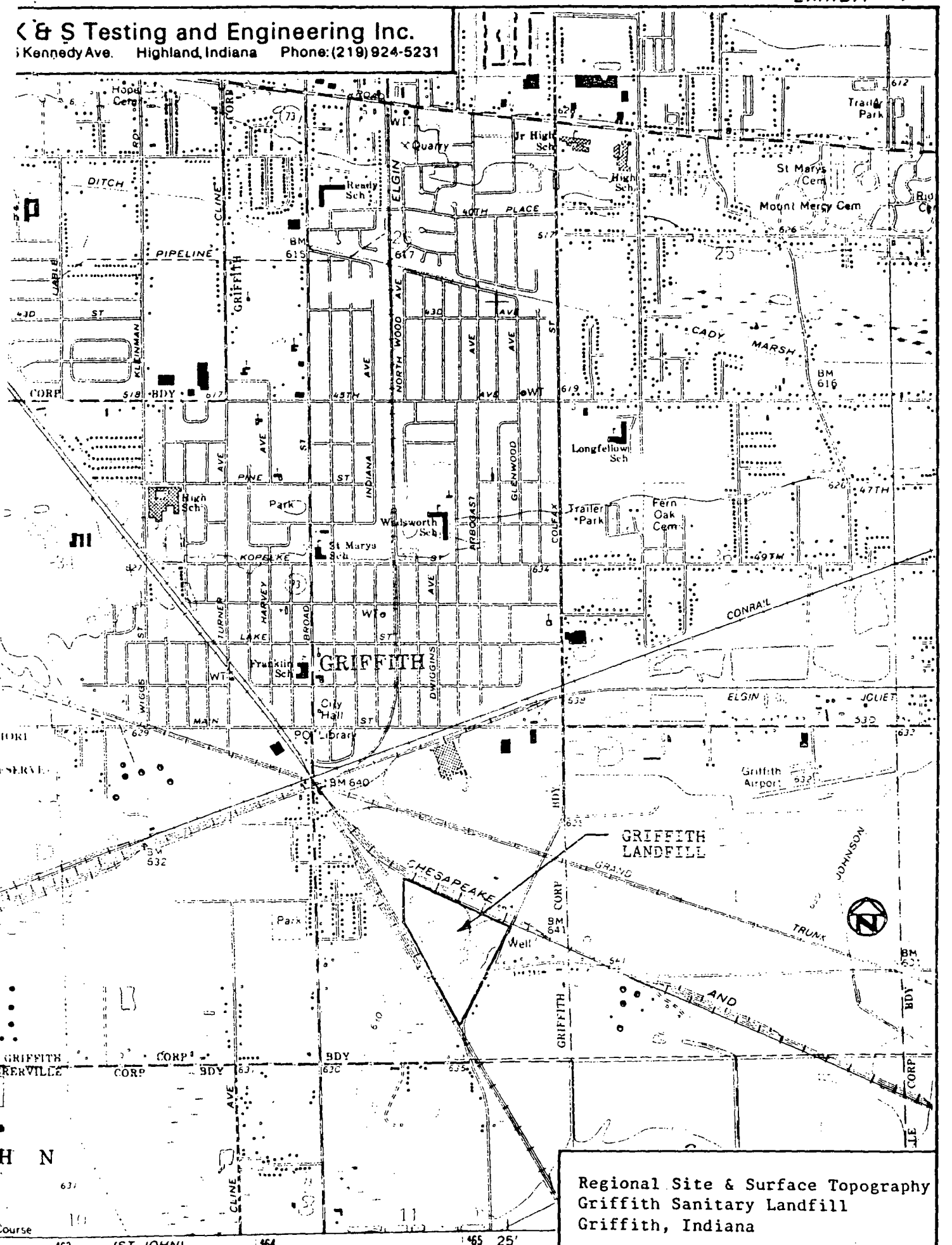
3. USGS Topographic Map, Department of Interior Geological Survey.

4. Foundation Engineering, Ralph B. Peck, Walter E. Hanson, and Thomas H. Thornburn.

5. Environmental Geology of Lake and Porter Counties, Indiana - An Aid to Planning, Edwin J. Hartke, John R. Hill, and Mark Reshkin, State of Indiana Department of Natural Resources, Geological Survey.

EXHIBIT 1

K & S Testing and Engineering Inc.
Kennedy Ave. Highland, Indiana Phone: (219) 924-5231



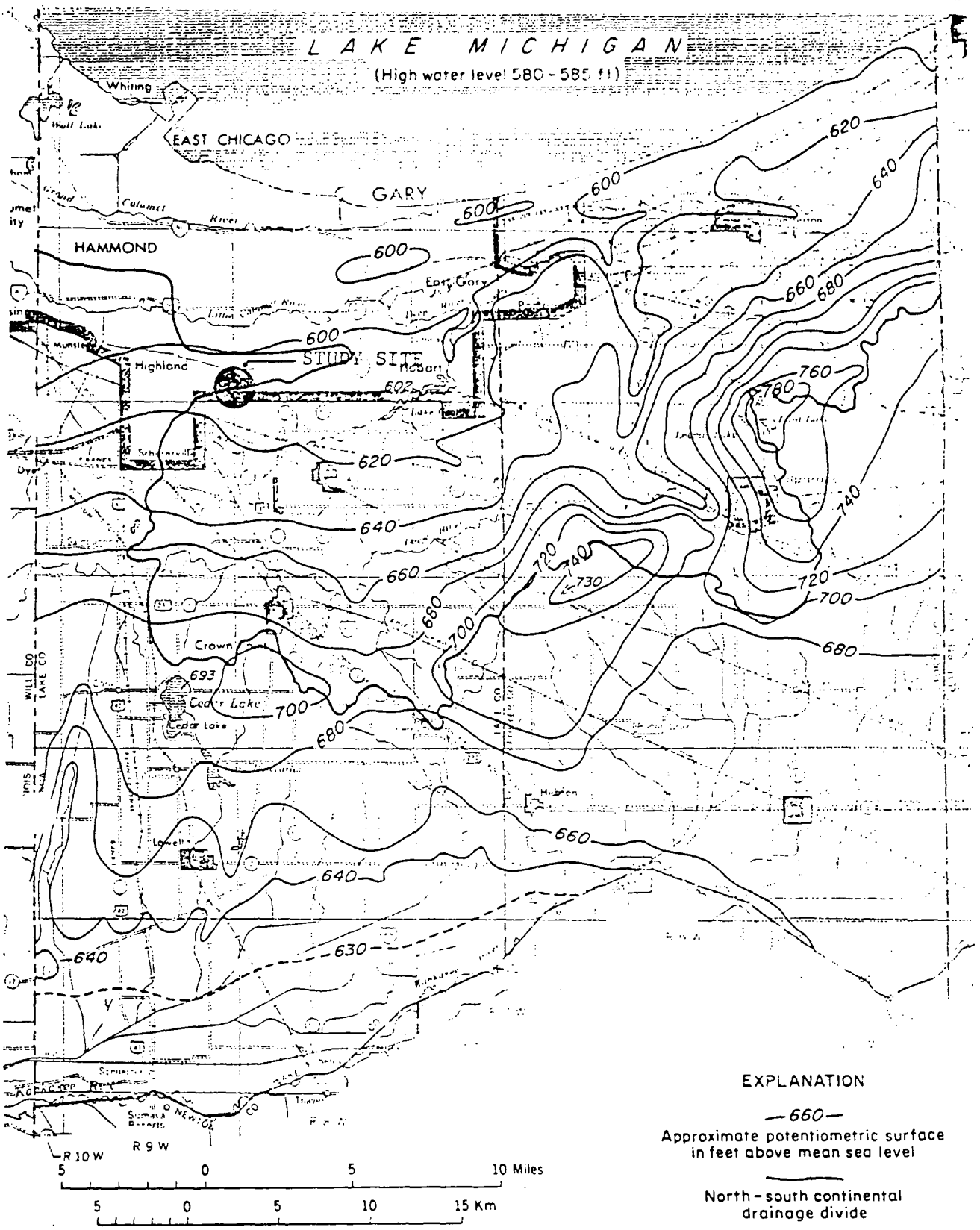
Regional Site & Surface Topography
Griffith Sanitary Landfill
Griffith, Indiana

FILE 220 DATE 5/3/86

463 (ST JOHN) 464 465 25'
3566 IV NW
SCALE 1:24000

EXHIBIT 2

K & S Testing and Engineering Inc.
15 Kennedy Ave. Highland, Indiana Phone: (219) 924-5231



EXPLANATION

—660—
Approximate potentiometric surface in feet above mean sea level

North - south continental drainage divide

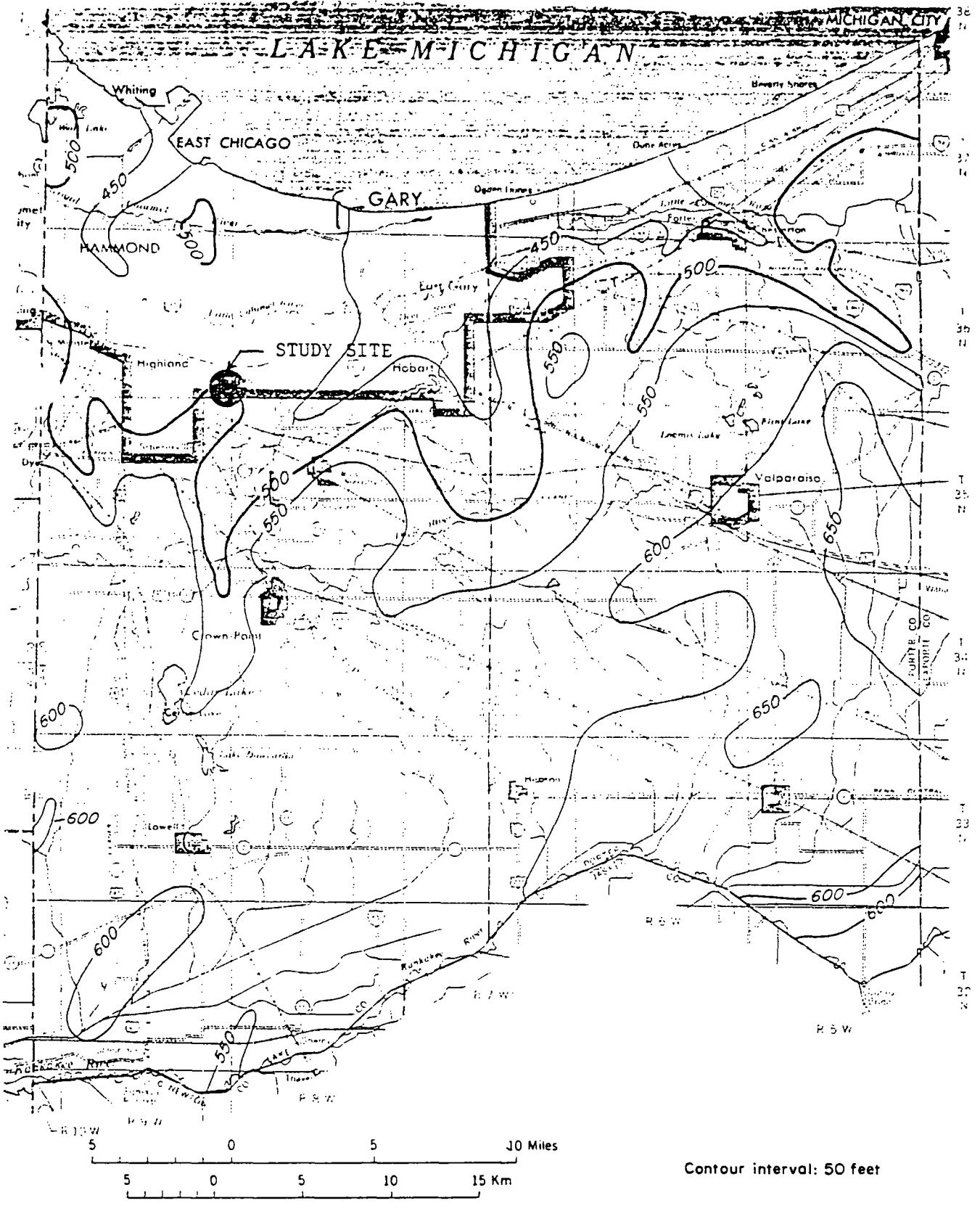
Reference:
Environmental Geology of
Lake and Porter Counties, Indiana
Special Report 11.

Regional Potentiometric Surface
Griffith Sanitary Landfill
Griffith, Indiana

FILE 220 **DATE** 5/3/86

EXHIBIT

K & S Testing and Engineering Inc.
15 Kennedy Ave. Highland, Indiana Phone: (219) 924-5231



Contour interval: 50 feet

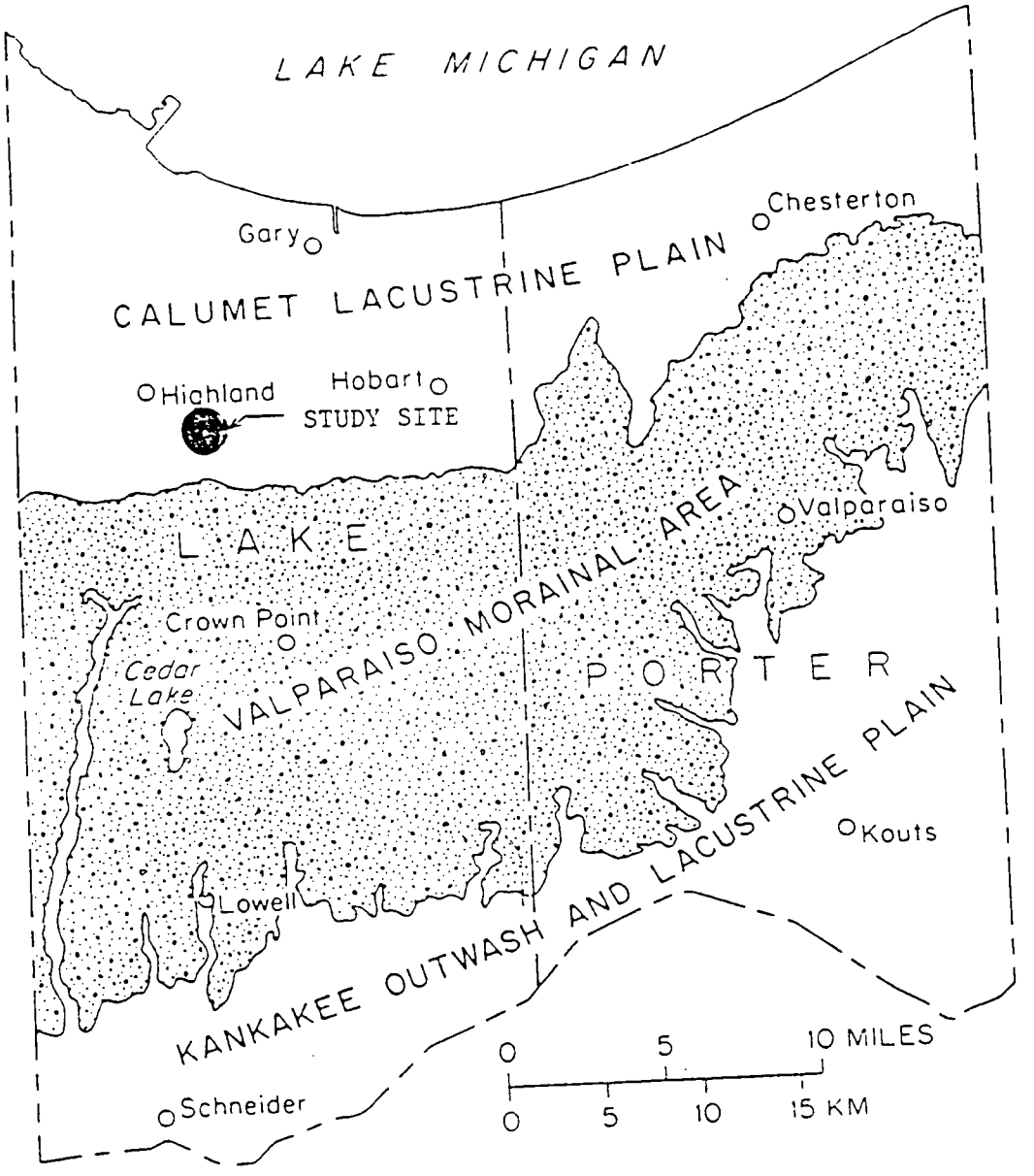
REFERENCE:

Environmental Geology of
Lake and Porter Counties, Indiana
Special Report 11.

Regional Rock Surface Contours
Griffith Sanitary Landfill
Griffith, Indiana

FILE 220 DATE 5/3/86

K·& S Testing and Engineering Inc.
5 Kennedy Ave. Highland, Indiana Phone: (219) 924-5231



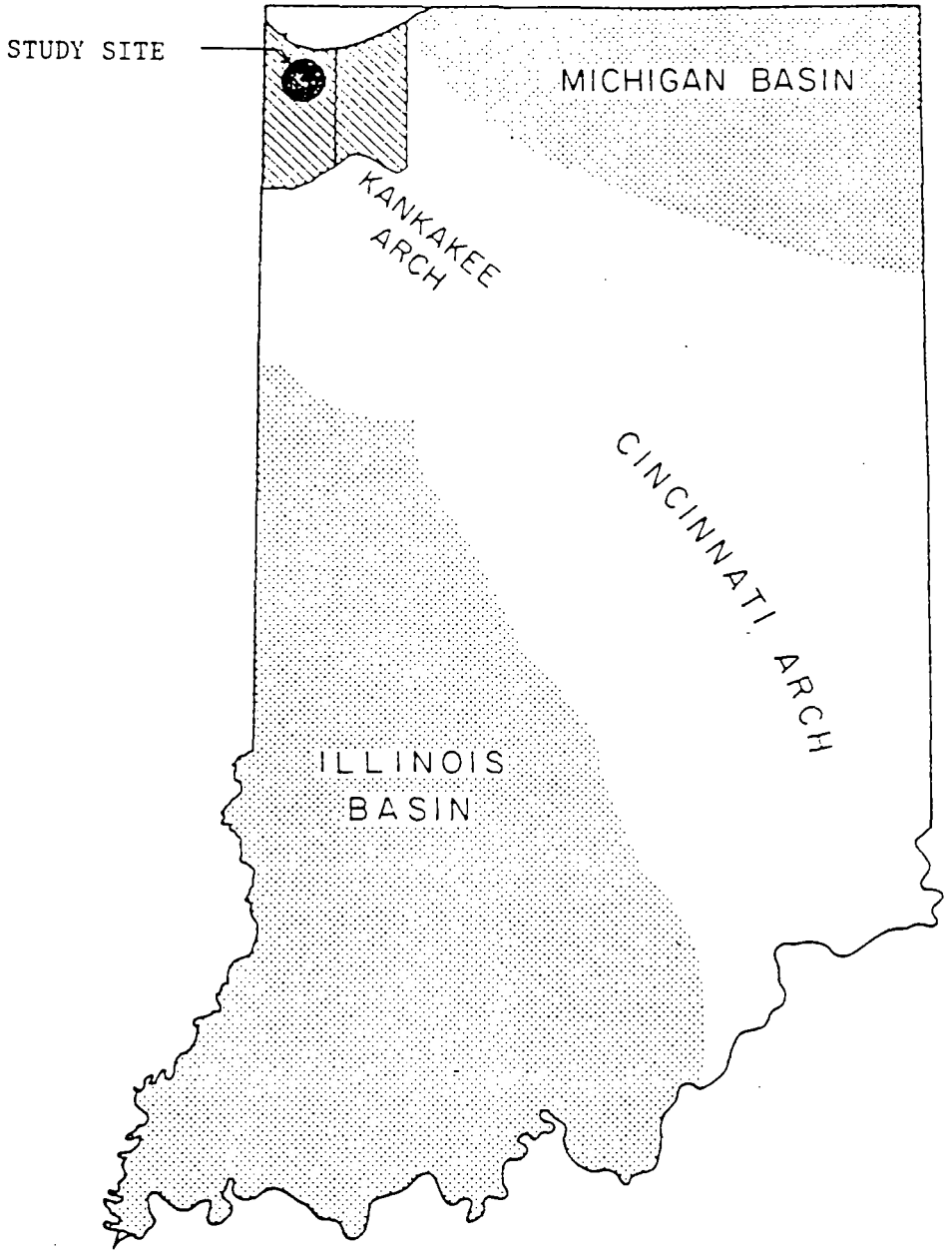
REFERENCE:
Environmental Geology of
Lake and Porter Counties, Indiana
Special Report 11.

Physiographic Units
Griffith Sanitary Landfill
Griffith, Indiana

FILE 220 DATE 5/3/86

EXHIBIT

K & S Testing and Engineering Inc.
715 Kennedy Ave. Highland, Indiana Phone: (219) 924-5231

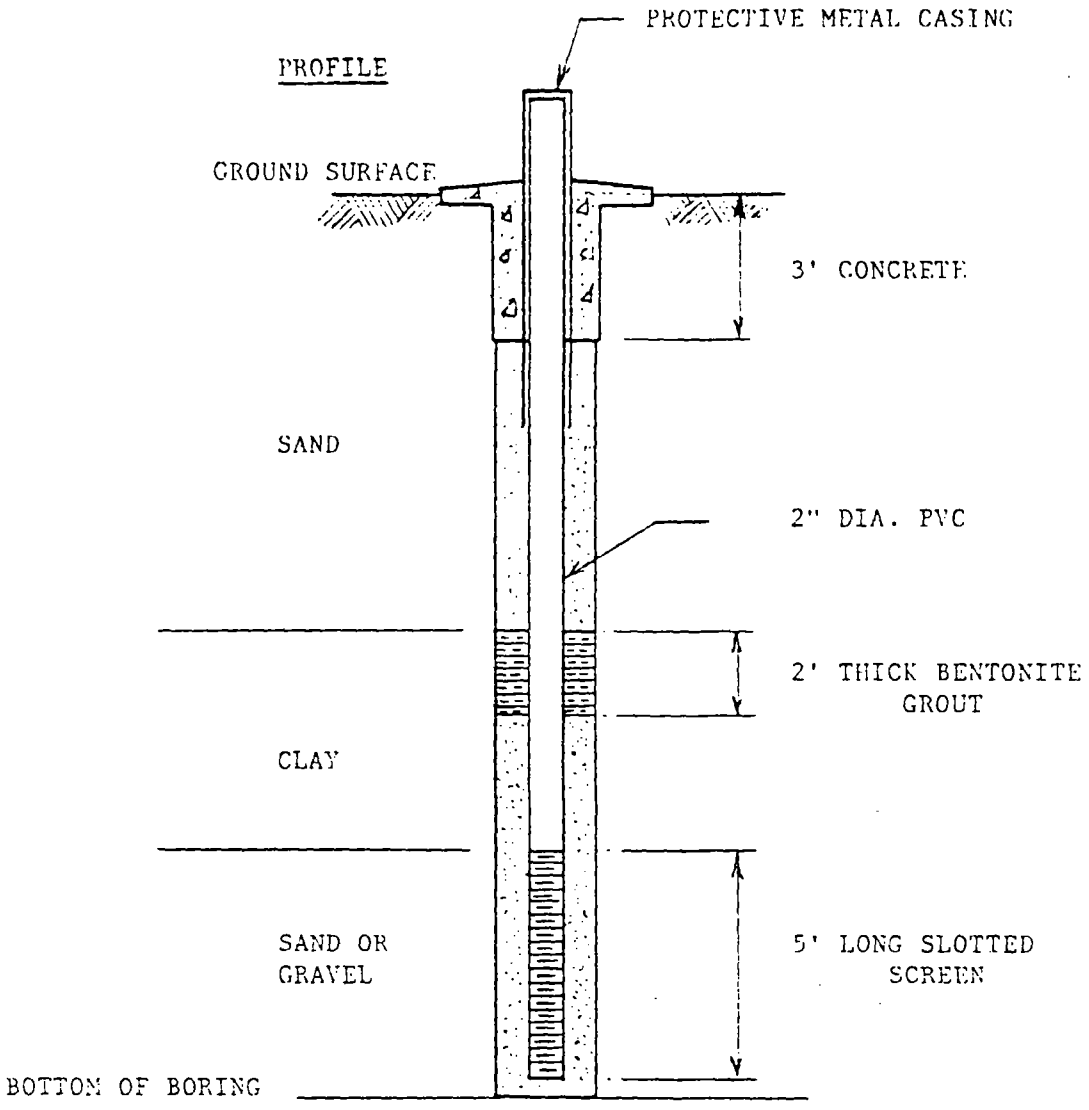


REFERENCE:
Environmental Geology of
Lake and Porter Counties, Indiana
Special Report 11.

Major Bedrock Structural Features
Griffith Sanitary Landfill
Griffith, Indiana

FILE 220 **DATE** 5/3/86

TYPICAL MONITORING WELL DETAILS



CONCRETE

BENTONITE

GRANULAR BACKFILL

WELL SCREEN

ENT
Torrenga Engineering

LOG OF BORING NUMBER
SB-6

E LOCATION
Colfax Avenue, Griffith, Indiana

PROJECT NAME
Griffith Sanitary Landfill

NG TED 01-29-86 | RIG CME-55

NG PLETED 01-29-86 | FOREMAN D. Koditek

FILE NUMBER
220

SURFACE ELEVATION 611.55

CALIBRATED PENETROMETER, TONS/FT²

UNCONFINED COMPRESSIVE STRENGTH, TONS/FT²

1 2 3 4 5

WATER CONTENT PERCENT

10 20 30 40 50

STANDARD PENETRATION, BLOWS/FT.

10 20 30 40 50

(FT.)	DESCRIPTION OF MATERIAL	DEPTH (FT)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE NUMBER
	Very stiff gray silty clay.	2.5			1
		5.0			2
		7.5			3
		10.0			4
		12.5			5
2.0					6
2.3	Coarse gray sand.				7
3.1	Very stiff gray silty clay.				8
4.0	Fine to coarse gray sand.	15.0			9
	Very stiff gray silty clay.				
6.0	Medium dense gray fine to coarse sand.	17.5			10
8.0	Very stiff gray silty clay.	20.0			11
		22.5			12
					13
4.3					14
5.0	Fine to coarse grav sand.	25.0			

Water Level

84

WATER LEVEL WHILE DRILLING 14.0 ft.

WATER LEVEL Artesian flow was noted after last sample was pulled out.

SPLIT SPOON | SHELBY TUBE | AUGER | ROCK CORE

PL - PLASTIC LIMIT | LL - LIQUID LIMIT | γ_d - UNIT DRY WEIGHT

K & S TESTING AND ENGINEERING INC.
9715 KENNEDY AVENUE
HIGHLAND, INDIANA 46322
TELEPHONE: (219) 924-5231

EXHIBIT 8

IENT orrenga Engineering	LOG OF BORING NUMBER SB-7 (sheet 1)
E LOCATION Colfax Avenue, Griffith, Indiana	PROJECT NAME Griffith Sanitary Landfill
ING RTED 01-30-86 / RIG CME-55	FILE NUMBER 220
ING APLETED 01-31-86 / FOREMAN D. Koditek	
SURFACE ELEVATION 633.09	

CALIBRATED PENETROMETER, TONS/FT²
UNCONFINED COMPRESSIVE STRENGTH, TONS/FT²
1 2 3 4 5
WATER CONTENT PERCENT
10 20 30 40 50
STANDARD PENETRATION, BLOWS/FT.
10 20 30 40 50

STRATA DEPTH (FT.)	DESCRIPTION OF MATERIAL	DEPTH (FT.)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE NUMBER
	Medium dense dark brown fine to medium sand.	2.5			1, 2
3.0	Medium dense brown fine to medium sand.	5.0			3, 4
7.0	Medium dense gray fine to medium sand.	7.5, 10.0, 12.5			5, 6, 7, 8
14.0	Very stiff hard gray silty clay.	15.0, 17.5, 20.0, 22.5			9, 10, 11, 12, 13, 14, 15

Water Level

▼ WATER LEVEL WHILE DRILLING 6.0 ft.
▼ WATER LEVEL

SPLIT SPOON ■ SHELBY TUBE A AUGER ROCK CORE
+PL - PLASTIC LIMIT +LL - LIQUID LIMIT γ_d - UNIT DRY WEIGHT

K & S TESTING AND ENGINEERING INC.
9715 KENNEDY AVENUE
HIGHLAND, INDIANA 46322
TELEPHONE: (219) 924-5231

CLIENT
Torrenga Engineering

LOG OF BORING NUMBER
SB-7 (sheet 2)

SITE LOCATION
Colfax Avenue, Griffith, Indiana

PROJECT NAME
Griffith Sanitary Landfill

BORING STARTED 01-30-86 | RIG CME -55

BORING COMPLETED 01-31-86 | FOREMAN D. Koditek

FILE NUMBER 220

SURFACE ELEVATION 633.09

CALIBRATED PENETROMETER, TONS/FT²
UNCONFINED COMPRESSIVE STRENGTH, TONS/FT²
1 2 3 4 5
WATER CONTENT PERCENT
10 20 30 40 50
STANDARD PENETRATION, BLOWS/FT.
10 20 30 40 50

STRATA DEPTH (FT.)	DESCRIPTION OF MATERIAL	DEPTH (FT.)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE NUMBER
	Very stiff hard gray silty clay.	27.5			15, 16
29.8		30.0			17
	Dense gray fine to medium sand.	32.5			18, 19
		35.0			20, 21
		37.5			22, 23
		40.0			24
		42.5			25
		45.0			26, 27
47.5		47.5			28
	Very dense gray fine to medium sand.				29

52
64

WATER LEVEL WHILE DRILLING 6.0 ft.
WATER LEVEL

SPLIT SPOON | SHELBY TUBE | AUGER | ROCK CORE
+PL - PLASTIC LIMIT | +LL - LIQUID LIMIT | γ_d - UNIT DRY WEIGHT

K & S TESTING AND ENGINEERING INC.
9715 KENNEDY AVENUE
HIGHLAND, INDIANA 46322
TELEPHONE: (219) 924-5231

CLIENT	LOG OF BORING NUMBER
Torrenga Engineering	SB-7 (sheet 3)
SITE LOCATION	**PROJECT NAME**
Colfax Avenue, Griffith, Indiana	Griffith Sanitary Landfill
BORING STARTED 01-30-86 / RIG CME-55	FILE NUMBER 220
BORING COMPLETED 01-31-86 / FOREMAN D. Koditek	

SURFACE ELEVATION 633.09

⊕ CALIBRATED PENETROMETER TONS/FT²

○ UNCONFINED COMPRESSIVE STRENGTH, TONS/FT²

● WATER CONTENT PERCENT

△ STANDARD PENETRATION, BLOWS/FT.

STRATA DEPTH (FT.)	DESCRIPTION OF MATERIAL	DEPTH (FT.)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE NUMBER	1 2 3 4 5	10 20 30 40 50	10 20 30 40 50
	Very dense gray fine to medium sand.	52.5			29			102 △
					30			80 △
					31			54 △
54.5	END OF BORING							

▼ WATER LEVEL WHILE DRILLING 6.0 ft.

▼ WATER LEVEL

SPLIT SPOON ■ SHELBY TUBE [A] AUGER ▨ ROCK CORE

+PL - PLASTIC LIMIT +LL - LIQUID LIMIT γ_d - UNIT DRY WEIGHT

K & S TESTING AND ENGINEERING INC.
9715 KENNEDY AVENUE
HIGHLAND, INDIANA 46322
TELEPHONE: (219) 924-5231

CLIENT: Torrenga Engineering

LOG OF BORING NUMBER: SB-8 (sheet 1

SITE LOCATION: Colfax Avenue, Griffith, Indiana

PROJECT NAME: Griffi.

BORING STARTED: 01-31-86 | RIG: CME-55

BORING COMPLETED: 02-03-86 | FOREMAN: D. Koditek

FILE NUMBER: 220

SURFACE ELEVATION: 632.61

STRATA DEPTH (FT.)	DESCRIPTION OF MATERIAL	DEPTH (FT.)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE NUMBER
	Mixed black & brown sand fill.				1
1.5		2.5			2
	Medium dense gray fine to medium sand.	5.0			3
					4
		7.5			5
		10.0			6
					7
12.3		12.5			8
	Very stiff to hard gray silty clay.	15.0			9
					10
		17.5			11
		20.0			12
					13
		22.5			14
					15

TONS/FT.² STRENGTH. 1 5 50

WATER C 10 20

STANDARD PENE 10 20

Wate. Lev.

▼ WATER LEVEL WHILE DRILLING 3.0 ft.

▼ WATER LEVEL

SPLIT SPOON | SHELBY TUBE | A AUGER | ROCK CORE

+PL - PLASTIC LIMIT | +LL - LIQUID LIMIT | γ_d - UNIT DRY WEIGHT

K & S TESTING AND ENGINEERING INC.
9715 KENNEDY AVENUE
HIGHLAND, INDIANA 46322
TELEPHONE: (219) 924-5231

CLIENT	LOG OF BORING NUMBER
Torrenga Engineering	SB-8 (sheet 2)
SITE LOCATION	**PROJECT NAME**
Colfax Avenue, Griffith, Indiana	Griffith Sanitary Landfill
BORING STARTED 01-31-86 / RIG CME-55	FILE NUMBER 220
BORING COMPLETED 02-03-86 / FOREMAN D. Koditek	
SURFACE ELEVATION 632.61	

CALIBRATED PENETROMETER, TONS/FT.²
UNCONFINED COMPRESSIVE STRENGTH, TONS/FT²
1 2 3 4 5
WATER CONTENT PERCENT
10 20 30 40 50
STANDARD PENETRATION, BLOWS/FT.
10 20 30 40 50

STRATA DEPTH (FT.)	DESCRIPTION OF MATERIAL	DEPTH (FT.)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE NUMBER
	Very stiff to hard gray silty clay.	27.5			15
					16
		30.0			17
					18
		32.5			19
					20
35.3		35.0			
36.0	Medium dense gray fine to coarse sand.				21
		37.5			22
	Very stiff gray silty clay.				23
		40.0			
					24
		42.5			25
43.5					
44.0	Medium dense fine to medium sand, wet				
		45.0			26
	Very stiff gray silty clay.				27
47.0		47.5			
	Dense gray fine to medium sand, wet.				28
					29

WATER LEVEL WHILE DRILLING 3.0 ft.
WATER LEVEL

SPLIT SPOON | SHELBY TUBE | AUGER | ROCK CORE

+PL - PLASTIC LIMIT | +LL - LIQUID LIMIT | γ_d - UNIT DRY WEIGHT

K & S TESTING AND ENGINEERING INC.
9715 KENNEDY AVENUE
HIGHLAND, INDIANA 46322
TELEPHONE: (219) 924-5231

CLIENT: Torrenga Engineering	LOG OF BORING NUMBER: SB-8 (sheet 3)
SITE LOCATION: Colfax Avenue, Griffith, Indiana	PROJECT NAME: Griffith Sanitary Landfill
BORING STARTED: 01-31-86	RIG: CME-55
BORING COMPLETED: 02-03-86	FOREMAN: D. Koditek
	FILE NUMBER: 220

SURFACE ELEVATION: 632.61

CALIBRATED PENETROMETER TONS/FT.

UNCONFINED COMPRESSIVE STRENGTH, TONS/FT.

WATER CONTENT PERCENT

STANDARD PENETRATION, BLOWS/FT.

STRATA DEPTH (FT.)	DESCRIPTION OF MATERIAL	DEPTH (FT.)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE NUMBER	STANDARD PENETRATION, BLOWS/FT.
	Dense gray fine to medium sand, wet.	52.5			29 30 31	69
54.5	END OF BORING					

WATER LEVEL WHILE DRILLING 3.0 ft.

WATER LEVEL

SPLIT SPOON SHELBY TUBE AUGER ROCK CORE

+PL - PLASTIC LIMIT +LL - LIQUID LIMIT γ_d - UNIT DRY WEIGHT

K & S TESTING AND ENGINEERING INC.
9715 KENNEDY AVENUE
HIGHLAND, INDIANA 46322
TELEPHONE: (219) 924-5231

SOIL TEST DATA

PROJECT Griffith Landfill CITY OR COUNTY Griffith, IN

LAB NO.	220-1	220-2	220-3
LOCATION	3" Shelby tube 3' South of Boring 6	3" Shelby tube 5' SE of Boring 6	Boring 6
DEPTH (feet)	0.0 - 1.5	0.0 - 1.5	5.5 - 7.0
GRAIN SIZE CLASSIFICATN	Gray silty clay (CL)	Gray silty clay (CL)	Gray silty clay (CL)
PASSING 1" SIEVE %			
3/4" " %			
1/2" " %			
No 4 " %	100.0	100.0	100.0
No 10 " %	99.2	99.2	99.3
No 40 " %	95.7	95.7	96.2
No 100 " %	92.9	92.9	93.1
No 200 " %	90.8	90.8	90.2
GRAVEL %			
SAND %	9.0	9.0	10.0
FINES (silt & clay) %	91.0	91.0	90.0
LIQUID LIMIT %	32.0	32.0	31.0
PLASTIC LIMIT %	19.0	19.0	17.0
PLASTICITY INDEX %	13.0	13.0	14.0
DRY DENSITY PCF	116.2	107.1	
PROCTOR DENSITY PCF			
OPTIMUM MOISTURE %			
PERCENT DENSITY %			
COEFF. OF PERMEABL cm/sec	2.1×10^{-8}	2.4×10^{-8}	

REMARKS:

K&S TESTING & ENGINEERING INC.

SOIL TEST DATA

PROJECT Griffith Landfill CITY OR COUNTY Griffith, IN

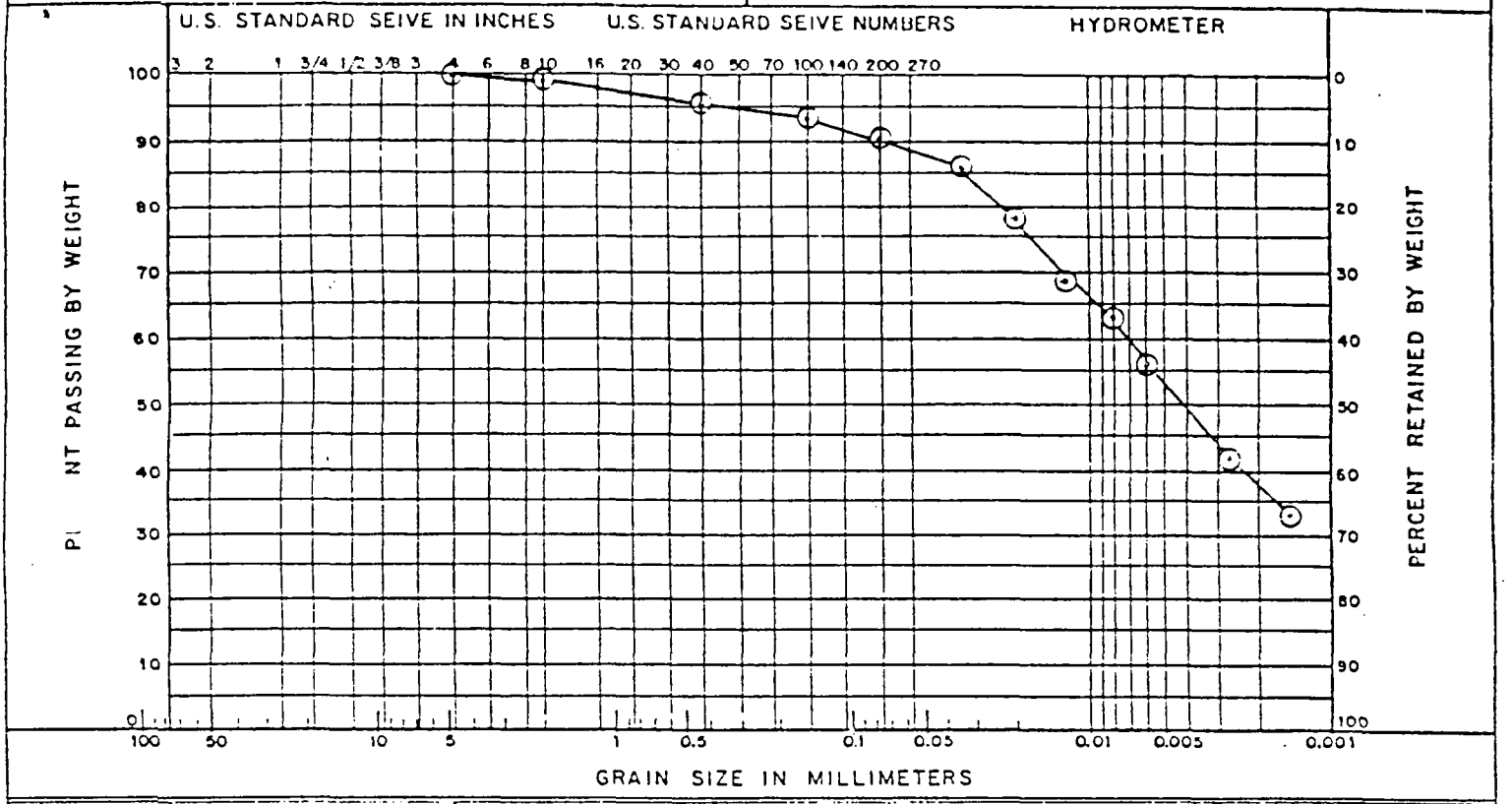
LAB NO.	220-4	220-5	
LOCATION	Boring 7	Boring 8	
DEPTH	16.0 - 17.5	21.0 - 23.0	
GRAIN SIZE CLASSIFICATN	Gray silty clay (CL)	Gray silty clay (CL)	
PASSING 1" SIEVE %			
3/4" " %			
1/2" " %	100.0	100.0	
No 4 " %	99.2	99.5	
No 10 " %	98.6	98.3	
No 40 " %	96.2	96.3	
No 100 " %	92.8	93.5	
No 200 " %	90.7	91.5	
GRAVEL %	1.0	1.0	
SAND %	8.0	8.0	
FINES (silt & clay) %	91.0	91.0	
LIQUID LIMIT %	31.0	29.0	
PLASTIC LIMIT %	19.0	17.0	
PLASTICITY INDEX %	12.0	12.0	
DRY DENSITY PCF			
PROCTOR DENSITY PCF			
OPTIMUM MOISTURE %			
PERCENT DENSITY %			
COEFF. OF PERMEABL cm/sec			

REMARKS:

EXHIBIT 12

K&S TESTING & ENGINEERING INC.

GRAIN SIZE DIAGRAM



STANDARD									
UNIFIED	GRAVEL		SAND			SILT AND CLAY FINES		COLLOIDS
	COARSE	FINE	COARSE	MEDIUM	FINE			
ASTM	GRAVEL		SAND			SILT AND CLAY FINES		COLLOIDS
			COARSE	MEDIUM	FINE			
AASHO	GRAVEL			SAND		SILT	CLAY	COLLOIDS
	COARSE	MEDIUM	FINE	COARSE	FINE			

SIEVE ANALYSIS DATA

SEIVE SIZE	PERCENT RETAINED	PERCENT PASSING	SPECS.*	GRAIN SHAPE	
FM =					

*SPECIFICATIONS USED _____

Near
T.B. NO. 6 S. NO. ST#2 DEPTH FT. 1.5 FILE NO. 220

DESCRIPTION: Gray silty clay (CL)

DESIGN DATA

EFFECTIVE DIAMETER, D_{10}	=	
COEFF OF UNIFORMITY, $C_U = D_{60}/D_{10}$	=	
PERCENT MINUS 0.02 mm	=	
PERCENT OF BOULDERS	=	
PERCENT OF GRAVEL	=	
PERCENT OF SAND	=	9.0
PERCENT OF SILT, PERCENT OF CLAY > FINES	=	91.0

METHOD

ASTM D 422-72 _____

OTHER _____

GRAIN SHAPE KEY

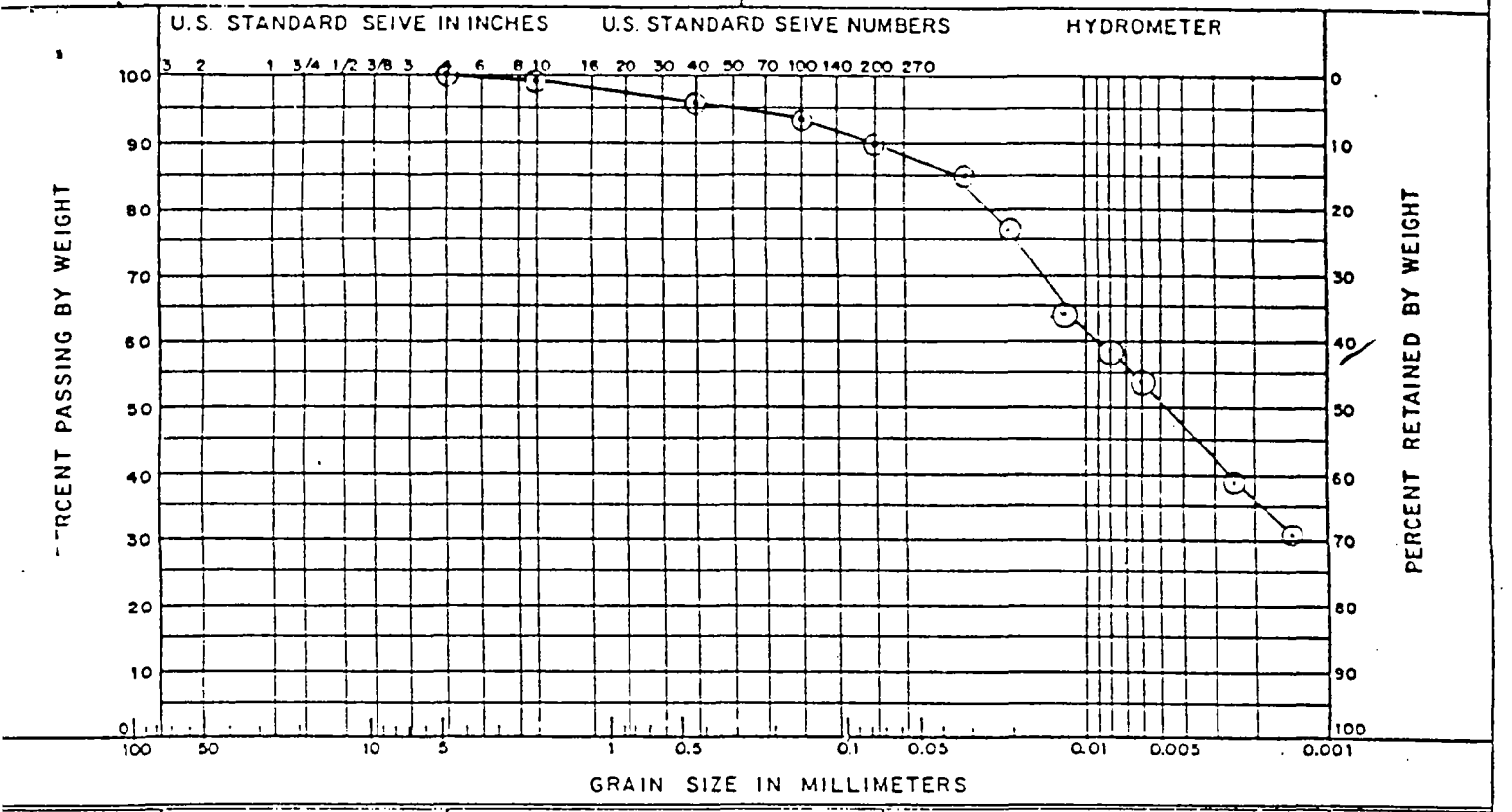
A-WELL ROUNDED	D-SUBANGULAR	G-FLAKE
B-ROUNDED	E-ANGULAR	H-POROUS
C-SUBROUNDED	F-ELONGATED	I-_____

REMARKS _____

EXHIBIT 13

K&S TESTING & ENGINEERING INC.

GRAIN SIZE DIAGRAM



STANDARD									
UNIFIED	GRAVEL		SAND			SILT AND CLAY FINES			COLLOIDS
	COARSE	FINE	COARSE	MEDIUM	FINE				
ASTM	GRAVEL		SAND			SILT AND CLAY FINES			COLLOIDS
			COARSE	MEDIUM	FINE				
AASHO	GRAVEL			SAND		SILT		CLAY	COLLOIDS
	COARSE	MEDIUM	FINE	COARSE	FINE				

SIEVE ANALYSIS DATA

SEIVE SIZE	PERCENT RETAINED	PERCENT PASSING	SPECS.*	GRAIN SHAPE	
FM =					

*SPECIFICATIONS USED _____

T.B. NO. 6 S. NO. 4 DEPTH FT. 7.0 FILE NO. 220

DESCRIPTION: Gray silty Clay (CL)

DESIGN DATA

EFFECTIVE DIAMETER, D_{10} = _____

COEFF OF UNIFORMITY, $C_U = D_{60}/D_{10}$ = _____

PERCENT MINUS 0.02 mm = _____

PERCENT OF BOULDERS = _____

PERCENT OF GRAVEL = _____

PERCENT OF SAND = 10.0

PERCENT OF SILT, PERCENT OF CLAY > FINES = 90.0

METHOD

ASTM D 422-72 _____

OTHER _____

GRAIN SHAPE KEY

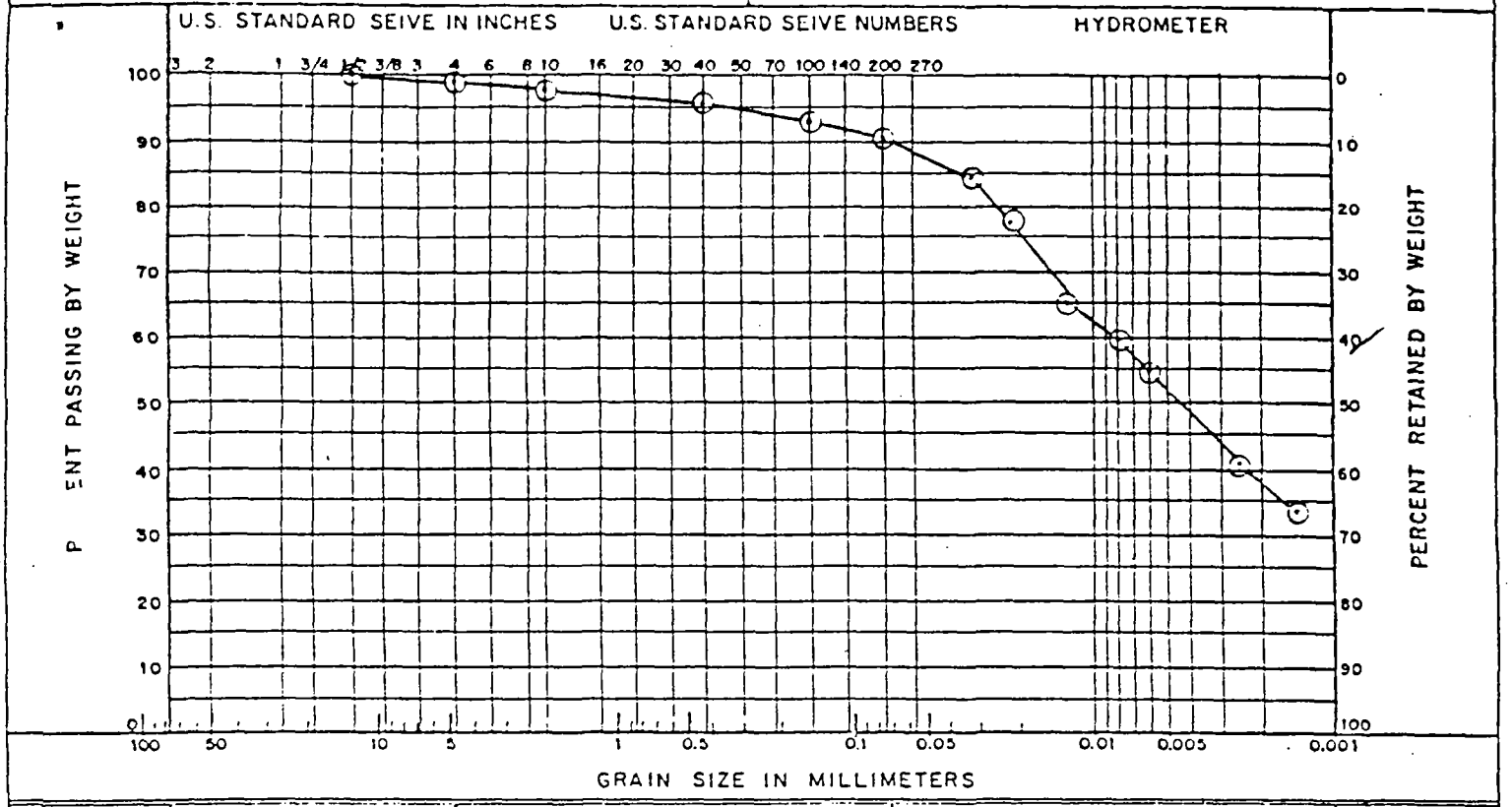
A-WELL ROUNDED D-SUBANGULAR G-FLAKE
B-ROUNDED E-ANGULAR H-POROUS
C-SUBROUNDED F-ELONGATED I-_____

REMARKS _____

EXHIBIT 14

K&S TESTING & ENGINEERING INC.

GRAIN SIZE DIAGRAM



STANDARD									
UNIFIED	GRAVEL		SAND			SILT AND CLAY FINES		COLLOIDS
	COARSE	FINE	COARSE	MEDIUM	FINE			
ASTM	GRAVEL		SAND			SILT AND CLAY FINES		COLLOIDS
			COARSE	MEDIUM	FINE			
AASHO	GRAVEL			SAND		SILT	CLAY	COLLOIDS
	COARSE	MEDIUM	FINE	COARSE	FINE			

SIEVE ANALYSIS DATA

SEIVE SIZE	PERCENT RETAINED	PERCENT PASSING	SPECS.*	GRAIN SHAPE	
FM =					

*SPECIFICATIONS USED _____

T.B.NO. 7 S.NO. 10 DEPTH FT. 17.5 FILE NO. 220

DESCRIPTION: Gray silty clay (CL)

DESIGN DATA

EFFECTIVE DIAMETER, D_{10}	=	
COEFF OF UNIFORMITY, $C_U = D_{60}/D_{10}$	=	
PERCENT MINUS 0.02 mm	=	
PERCENT OF BOULDERS	=	
PERCENT OF GRAVEL	=	1.0
PERCENT OF SAND	=	8.0
PERCENT OF SILT > FINES	=	91.0
PERCENT OF CLAY		

METHOD

ASTM D 422-72 _____

OTHER _____

GRAIN SHAPE KEY

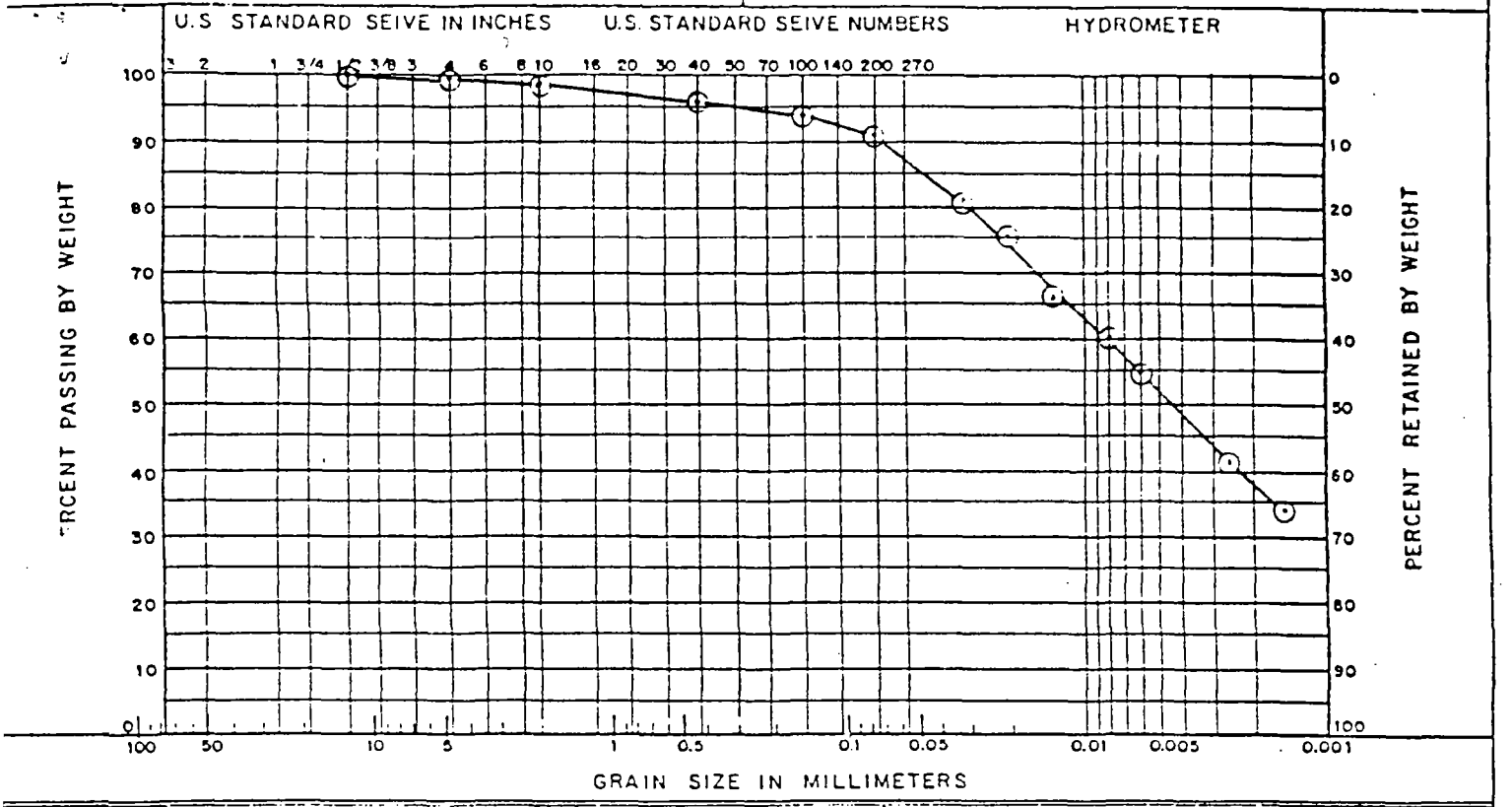
A-WELL ROUNDED	D-SUBANGULAR	G-FLAKE
B-ROUNDED	E-ANGULAR	H-POROUS
C-SUBROUNDED	F-ELONGATED	I-_____

REMARKS _____

EXHIBIT 15

K&S TESTING & ENGINEERING INC.

GRAIN SIZE DIAGRAM



STANDARD	GRAVEL		SAND			SILT AND CLAY FINES		COLLOIDS
UNIFIED	COARSE	FINE	COARSE	MEDIUM	FINE			
ASTM	GRAVEL		SAND			SILT AND CLAY FINES		COLLOIDS
			COARSE	MEDIUM	FINE			
AASHO	GRAVEL			SAND		SILT	CLAY	COLLOIDS
	COARSE	MEDIUM	FINE	COARSE	FINE			

SIEVE ANALYSIS DATA

SIEVE SIZE	PERCENT RETAINED	PERCENT PASSING	SPECS.*	GRAIN SHAPE	
FM =					

*SPECIFICATIONS USED _____

T.B. NO. 8 S. NO. 13 DEPTH FT. 23.0 FILE NO. 220

DESCRIPTION: Gray silty clay (CL)

DESIGN DATA

EFFECTIVE DIAMETER, D_{10}	=	
COEFF OF UNIFORMITY, $C_U = D_{60}/D_{10}$	=	
PERCENT MINUS 0.02 mm	=	
PERCENT OF BOULDERS	=	
PERCENT OF GRAVEL	=	1.0
PERCENT OF SAND	=	8.0
PERCENT OF SILT > FINES	=	91.0
PERCENT OF CLAY		

METHOD

ASTM D 422-72 _____

OTHER _____

GRAIN SHAPE KEY

A-WELL ROUNDED D-SUBANGULAR G-FLAKE
B-ROUNDED E-ANGULAR H-POROUS
C-SUBROUNDED F-ELONGATED I-_____

REMARKS: _____

EXHIBIT 16

SUBURBAN LABORATORIES, Inc.

4140 LITT DRIVE HILLSIDE, ILLINOIS 60162 · 1183

ARL I. ROSENBERG
President

H.R. THOMAS, JR.
Director

May 6, 1986

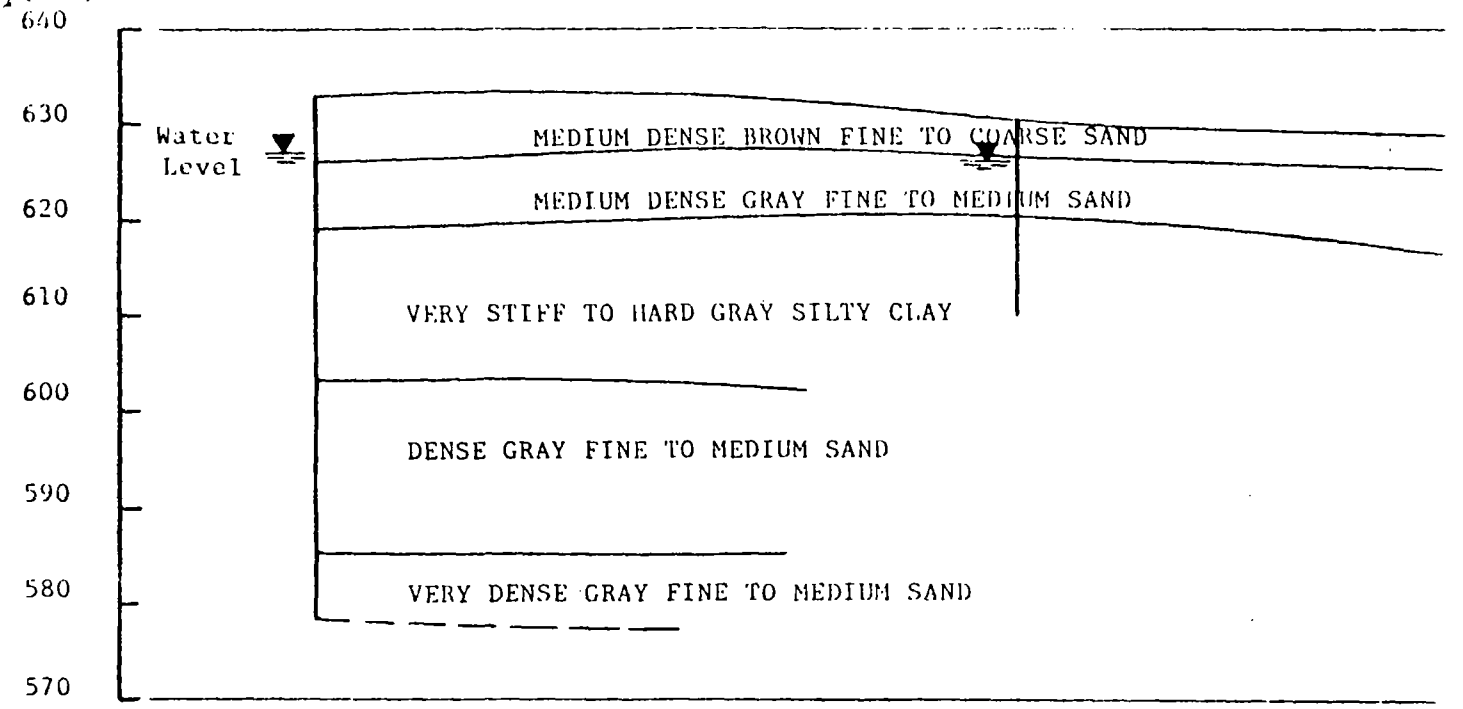
K & S Testing and Engineering Inc.
9715 Kennedy Avenue
Highland, Indiana 46322

Attention: Mr. Dibakar Sundi,
Project Engineer

Samples Received: 4/29/86	Cation Exchange (meq/100g)
Soil Samples / Griffith Landfill	
S/L #6-4558 - Sample #1, Depth 0 - 2.0 ft.	5.64
S/L #6-4559 - Sample #2, Depth 2 - 3.5 ft.	5.55

ANALYSIS CERTIFIED BY: _____, Director(HRT/ak)

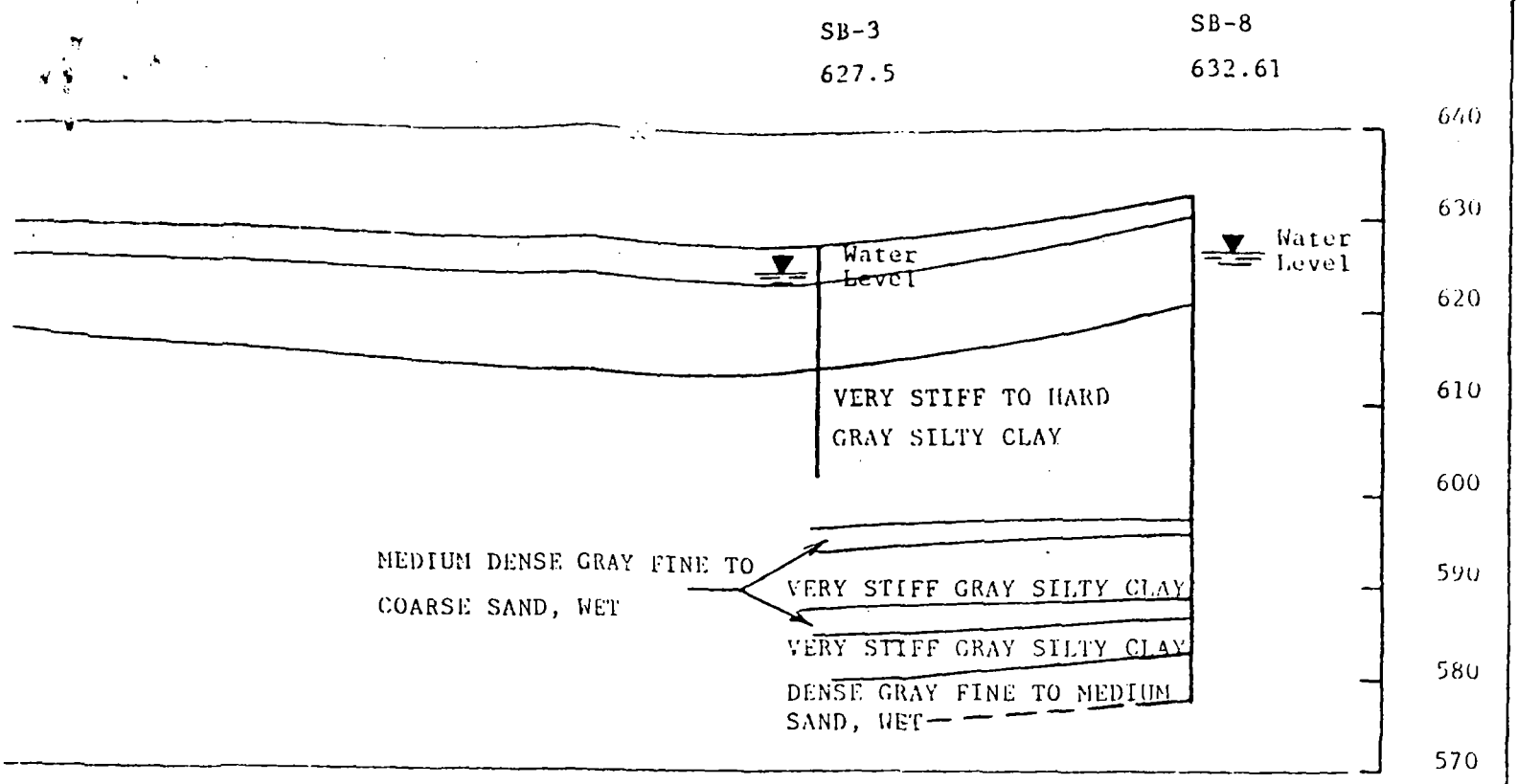
BORING NO.	SB-7	SB-4
ELEV. (ft.)	633.09	630.5

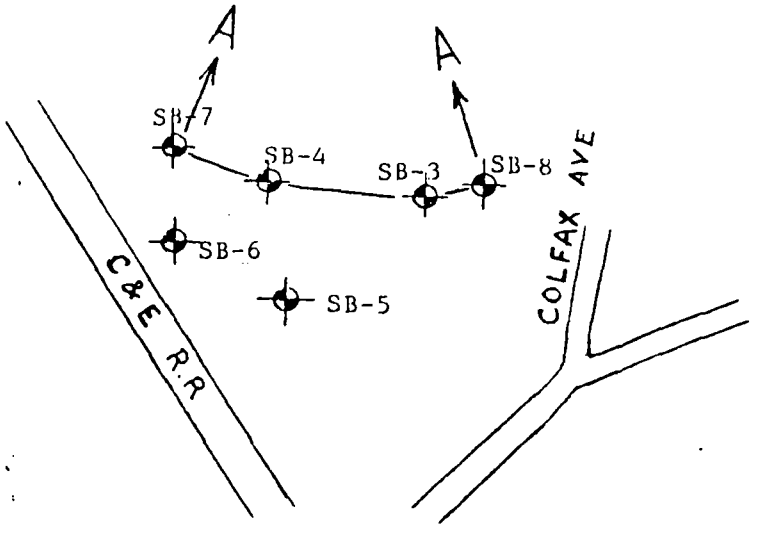


SCALE

HORIZONTAL: 1" = 75'

VERTICAL: 1" = 20'





SITE PLAN

GENERALIZED SUBSURFACE PROFILE THRU SECTION A-A
GRIFFITH SANITARY LANDFILL